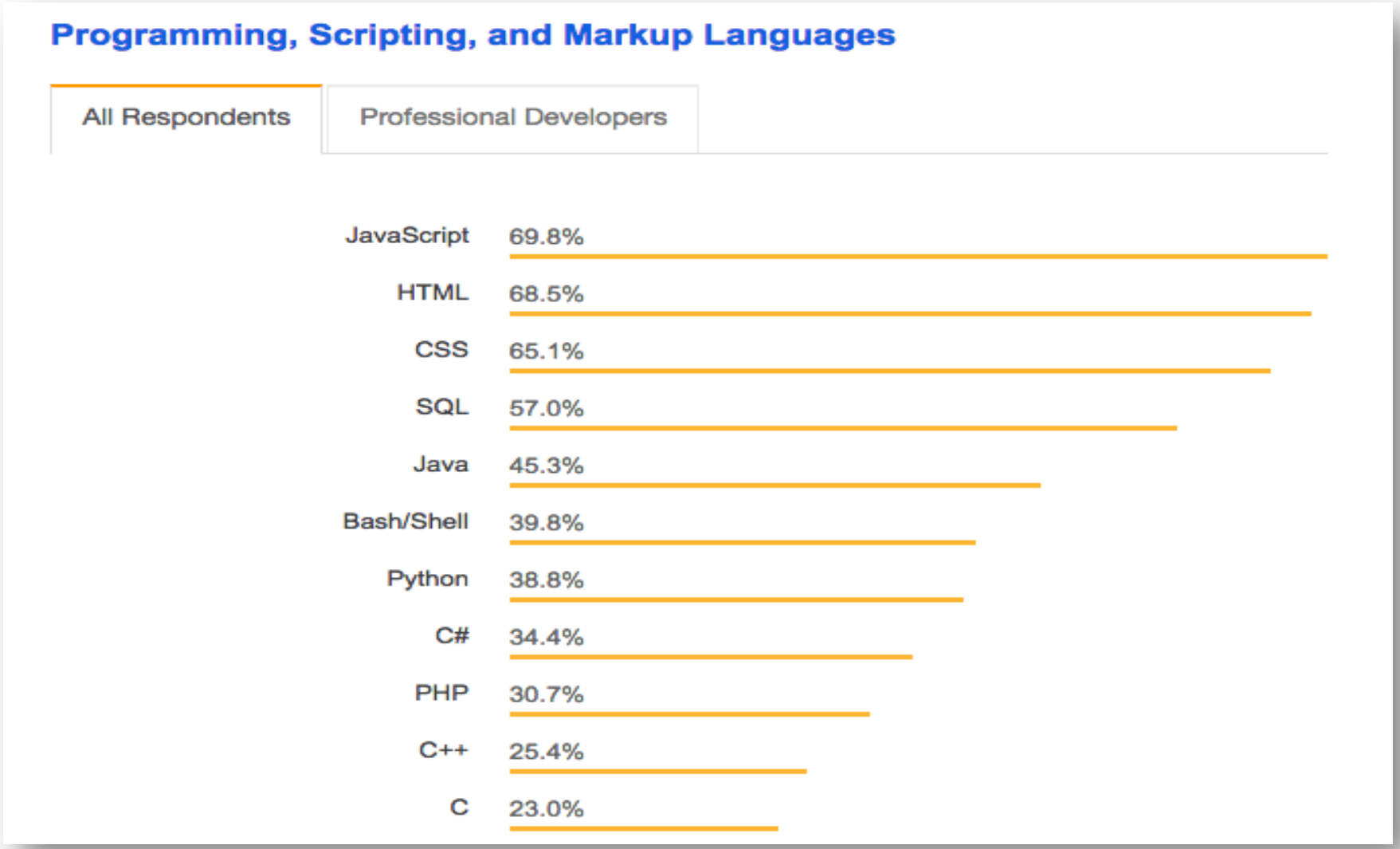
JavaScript.

The Fundamentals

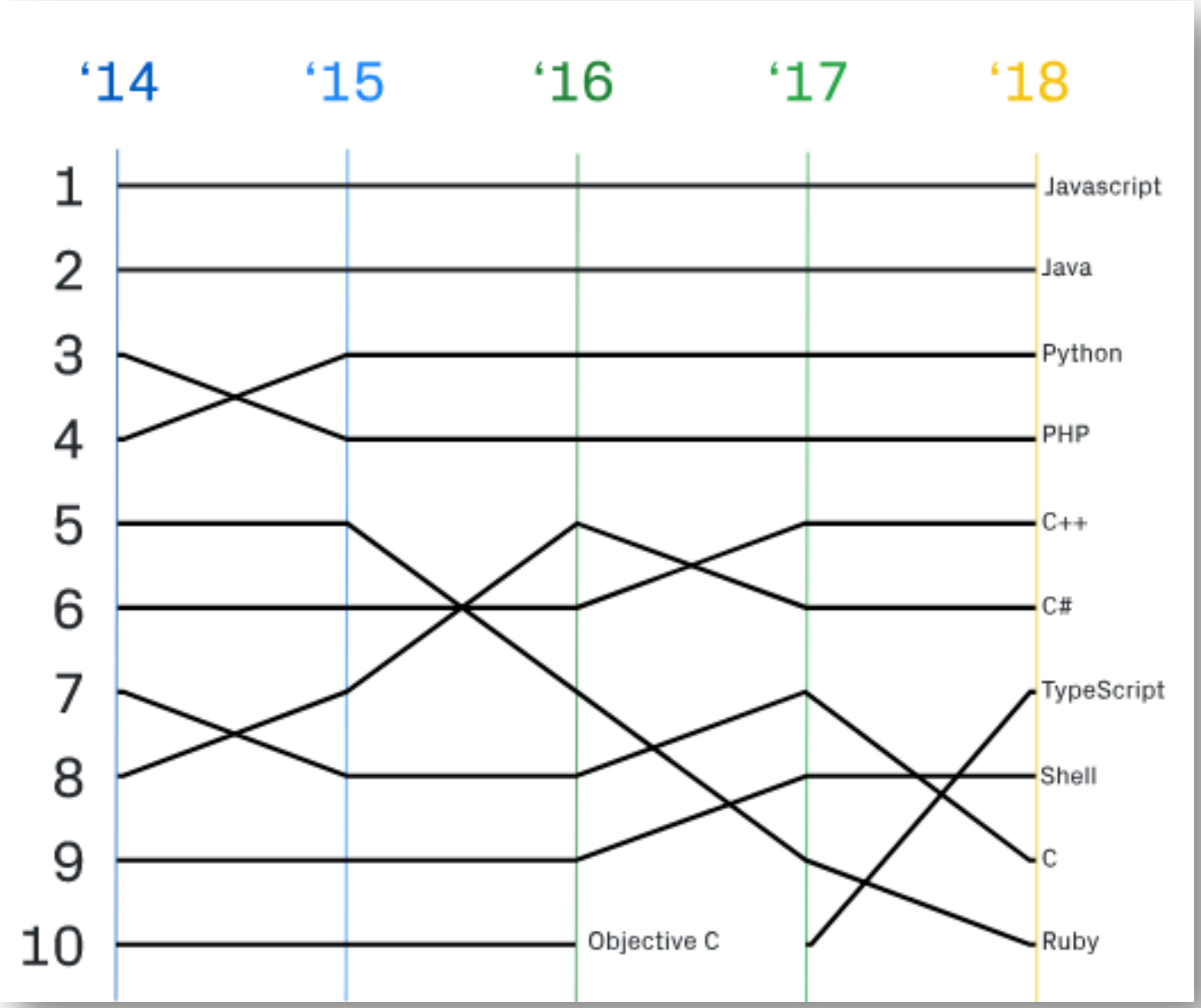
Topics

- **Background**
- **Data (State) representation**
  - **All about objects**
- **Behaviour representation**
  - **All about functions**

Ref. https://insights.stackoverflow.com/survey/2018?



Ref : https://octoverse.github.com/projects



Background.

- **Designed by Brendan Eich, at Netscape Corp. (early 1990s).**
  - **Influenced heavily by Java, Self and Scheme.**
- **Named JavaScript to capitalizing on Java's popularity.**
- **Netscape submitted JavaScript to ECMA for Standardization. (ECMA – European Computer Manufacturers Association. Organization that standardizes information)**
- **Resulted in new language standard, known as ECMAScript.**
  - **JavaScript is an implementation of ECMAScript standard.**
  - **ES1: June 1997; ES2: June 1998; ES3: Dec. 1999; ES4: Abandoned**
  - **ES5: 2009; ES6: 2015 (ES2015); ES2016/7 ….**
- **The** node.js **platform (2009).**
  - **JavaScript on the server-side**
- **Douglas Crockford – 'JavaScript - Volume 1: The Early Years'**

Transpilation (using Babel)

- **Browsers cannot execute ES6+ Javascript**
  - **Must transpile code first.**
- **The Babel tool suite.**
- **Node.js platform incrementally adopting ES6+._**

JavaScript - Data representation.

JavaScript Data Types.

- **Data types:**
  1. **Primitives: number, string, boolean, null, undefined.**

  2. **Everything else is an object.**

- **JS is a dynamically typed language.**

Primitive types.

- **Suppose we have a file** *01_primitives.js:*

```
let foo1 = 5 ;
let foo2 = 'Hello' ;
let foo3 = true ;
let foo4 = null ;
console.log( foo1 + ' ' + foo2 + ' ' + foo3 + ' ' + foo4) ;
foo1 = 3 ;    // Reassign foo1. No need for let keyword.
foo2 = 10 ;  // JS is dynamically typed. Great, but don't misuse!!
let foo5 ;
console.log (foo5) ;
```

- **Execute it from the command line using** node.js **platform – no browser needed.**

```
diarmuidoconnor@samplecode $ node 01_primitives.js
5 Hello true null
undefined
diarmuidoconnor@samplecode $
```

Primitive types (Basic syntax).

```
let foo = 20 ;
```

- let **– keyword to indicate we are declaring 'something' (and assigning it a literal value in above case).**
  - **Block scope – same as Java.**
- Identifier **– 'foo' is an identifier for the thing being declared.**
  - **Lots of rules about valid format for identifiers (no spaces, don't start with numeric character, etc)**
- Operator **– e.g. +, =, * (multiply), –, [ ] (subscript) etc**
  - **Some rules about where they can appear in a statement.**
- Semicolon **(;) – statement terminator.**
  - **Optional.**
  - **Babel puts them back in - ASI.**
  - **Avoid multiline expressions.**

Objects.

- **The fundamental structure for representing complex data.**
- **A unit of composition for data (or STATE).**
- **Literal syntax:**

  { <key1> : <value1>, <key2> : <value2>, ... }

- **Objects are a set of** key-value **pairs, termed** properties**.**
  - **Key (property name) - an identifier; must be unique within the object structure.**
  - **Value - can be a literal value, another object (nesting) or array.**

Example:

let me = { firstName: “Diarmuid”, lastName: “O’ Connor” } ;

Manipulating Object properties.

- **Two notations:**
  1. **Dot notation e.g** let fn = me.firstName ;
  2. **Subscript notation e.g.** me['firstName’] (Note quotes)
- **Same notations for** changing **a property value:**

  me.firstName = ‘Jeremiah’ ;

  me[‘lastName’] = ‘O Conchubhair’ ;
- **Subscript notation allows a variable reference as the key:**

  let foo = ‘lastName’ ;

  console.log (‘Surname: ’ + me[foo]) ;

  me[foo] = …….. ;

- **Ref. 02_objects.js**

Object characteristics.

- **Objects are dynamic:**
  - **Properties can be inserted and removed at run-time (JS is dynamic).**
  - **Ref. sample 03,**
- **Nested objects.**
  - **A property value may be an object structure.**
  - **Ref. sample 04_1,**
- **A property value can be a variable reference.**
  - **Ref. sample 04_2,**
- **Internally JS stores object keys as** strings**.**
  - **Hence the subscript notation** – me[‘address’].

Array data structure.

- **Dfn.: Array is an** ordered list **of values.**
  - **An object's properties are not ordered.**
- **Literal declaration syntax** :

  [<value1>, <value2>, ...]

- **Values can be of mixed** type (may reflect bad design!)**.**

- **Access elements with subscript notation.**
  - **Subscript termed an** index**.**

  - **Ref sample 05**

Array data structure.

- **In JS, arrays are really just ‘special’ objects.**
  - **Index converted to a string for subscript notation:**

    nums[2] **becomes** nums[‘2’]
- **Array objects have special properties built-in:**
  - **Length property, e.g.** let len = nums.length; // 4
  - **Utility methods for manipulating elements e.g push, pop, shift, unshift, join etc.**

Nested collections.

- **Arrays and objects are collection types.**
- **They can be nested.**
- **Ex.:**
  - **An array where elements are also arrays -** array_outer[3][2]
  - **An array of objects -** array_outer[1],propertyX.
  - **An object with a property whose value is an array -** objectY.propertyX[5**].**
  - **Etc.**

JavaScript - Behavior structures

JavaScript functions.

- **Fundamental unit of composition for logic (or BEHAVIOUR).**

  function <func_name>(<parameters>) {

  <body of code>

  } // end of function

  - **Some functions don't require parameters.**
  - **Function body is executed by calling it with** arguments**.**
  - **Declarations are "hoisted" to the top of the current scope.**
    - **Function call can appear before its declaration**

- **Ref. sample 06.**

JavaScript functions.

- **Functions can be created using:**
  1. **A declaration (above examples).**
  2. **An expression.**
  3. **A method (of a custom object).**
  4. **Anonymously.**

- **Can be called as:**
  1. **A function (above examples).**
  2. **A method of an object.**
  3. **A constructor.**

Function Expressions.

- **Defined using the syntax:** let name = function(...) { ... }
- **Invoked the same way as function declarations:**

  name(argument1, argument2, ...) ;
- **No “hoisting”.**
- **Useful for dynamically created functions.**
- **Ref sample 6**

Function Result.

- **Typically, functions perform some logic AND return a result.**
- **A function with no explicit return statement, returns ‘undefined’.**
- **Return type can also be a function**

Methods.

- **Method – A function associated with an object property.**
- **Syntax**: let objX = { …….
  methodY : function(….) { …. },
  …….. } ;
- **Invoking a method**: objX.methodY(….)
- **The** ‘this’ **special variable – used by a method to access other properties of the containing object**
- **Pre-ES6 feature of JS**
- **Syntax comparison:**
  - **Function**: computeTotal(person)
    addMiddleName(person,’Paul')
  - **Method:** person.computeTotal()
    person.addMiddleName(’Paul’**)**

Anonymous functions.

- **A function without a name:** function(...) { …. }
- **Mainly used for "callbacks" – when a function appears as a parameter for another function, which the latter calls.**
- **Simple Example:**
  - **The *forEach* array method.**
    - **A more elegant way of processing an array than for loops.**
  - **The setTimeout system function.**
- **Very common pattern.**
- **Be careful using 'this' inside an anonymuous function.**

- **[Any type of function (declaration, expression, method) can be used as a callback, not just anonymous functions.]**

Constructor functions.

- **The object literal syntax is not efficient for** creating multiple objects of a common ‘type’.
  - **Efficiency = Amount of source code.**

```
let customer1 = { name ’ Joe Bloggs’ ,
      address  : ‘1 Main St’ ,
      finances : {. . . . . },
      computeTotal : function () { . . . . },
      adjustFinance : function (change) { . . . }
  } ;
let customer2 = { name ’ Pat Smith’ ,
      address  : ‘2 High St’ ,
      finances : {. . . . . },
      computeTotal : function () { . . . . },
      adjustFinance : function (change) { . . . }
  } ;
let customer3 = . . . . .
```

Constructers solve this problem

Constructors.

- **Constructor - Function for creating an object of** *a custom type*.
  - **Custom type examples: Customer, Product, Order, Student, Module, Lecture.**
- **Idea borrowed from class-based languages, e.g. Java.**
  - **No classes in Javascript (prior to ECMAScript 6 - June 2015)**
- **Convention: Capitalize constructor name to distinguish it from 'ordinary' functions.**

  function Customer(. . .) { …..... }
- **Constructor invocation must be preceded by the new operator.**

  let customer1 = **new** Customer(. . . . .) ;

Constructors.

- **What happens when a constructor is called (with new) ?**
  1. **An empty object is created, ie. { }.**
  2. **The** this **variable is set to the new object.**
  3. **The constructor function is executed, as normal.**
  4. **The (default) return value is the object referenced by** this**.**

Summary

- **Representing Data / State**
  - **Primitives.**
  - **Objects.**
    - **Dynamic, nested.**
  - **Arrays.**
- **Defining Behaviour.**
  - **Functions:**
    - **Declarations.**
    - **Expressions.**
    - **Anonymuous.**
    - **Constructor.**